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AN ACCOUNT OF HORSBURGH OR GOIFURFEHENDU ATOLL

BY

R. B. SEYMOUR SEWELL, C.I.E., Sc.D., F.R.S.

(Lieut.-Colonel, I.M.S. (ret.).)

WITH SIX PLATES AND ONE TEXT-FIGURE

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This atoll is one of the western series of the Maldive atolls, and lies at the western end of Kardiva Channel, in about lat. 4° 51′ N., long. 72° 55′ E. Owing to its position it lies well within the influence of both the south-west and north-east monsoons, and thus differs considerably from Addu atoll.

Both Stanley Gardiner (1903, p. 377 *et seq.*) and Agassiz (1903, p. 54) have given accounts of the condition of the atoll at the time of their visits, and one is thus able to compare the conditions that were present in 1899 and 1902 respectively with that which was found to exist in 1934, when we visited it during the course of the John Murray Expedition.

The general shape of the atoll is pear-shaped or egg-shaped, with the more pointed end towards the east and its long axis running nearly east and west; the major diameter has a length of approximately ten miles from reef edge to reef edge, and the shorter north to south diameter is about half this. From the position of the atoll one would expect to find that the strongest winds experienced in the atoll during the course of the year would blow from the south-west during the period of the south-west monsoon in June–August; Agassiz has stated that the north-eastern part of the atoll is exposed to the full force of the north-east monsoon, but he seems to have overlooked the fact that the line of the eastern series of atolls and especially Fadiffolu atoll must to some, and possibly a large, extent protect Horsburgh atoll from the full effect of this wind, and Stanley Gardiner is more correct in his statement that the atoll is fully exposed to the south-west and west, but is to some extent sheltered on the north-west by the neighbouring atoll, South Malosmadulu, and especially by its eastern horn, that seemed to him to divert the currents of the north-east monsoon more or less away from the northern reef of Horsburgh. At the same time it must be pointed out that the greatest strength of the wind in this area is, according to the wind-charts published by the Koninklijk Nederlandsch Meteorologisch Instituut (1924–30), usually from a quarter between north-west and south-west, and that it blows from this quadrant almost continuously from April to the end of November.

Month.	Prevailing wind.	Force : Beaufort Scale.	
January	NE	2–3	NE monsoon.
February	NE	2–3	
March	N-E	2–3	
April	NW	3–4	
May	W	3–4	
June	W-SW	3–4	SW monsoon.
July	SW	2–3	
August	W	2–3	
September	W	3–4	
October	NW-W	3–4	
November	W	3–4	
December	N-E	2–3	NE monsoon.

During the periods of the year between the two monsoon seasons the north-west or west wind is more prevalent and blows more strongly. Although it is certain that in different years there will be a considerable range of variation in the meteorological conditions, during the period of our visit to the atoll in April, 1934, the prevailing wind was from the north-west or west-north-west, and the average strength was force 3 in the Beaufort scale. During the occurrence of cyclones in the Laccadive Sea to the east and north-east of the atoll there will be heavy winds from the north or north-west.

The only opening into the lagoon is situated in the western part of the south side of the atoll, so that, if the position be due to the prevailing wind and, therefore, on the lee side of the atoll, as is usually held to be the case, then this wind should be from the north or north-east ; and this would not be in agreement with the observations recorded above. At first sight there seems to be only a single entrance channel. Stanley Gardiner (1903, p. 377) states that there is " only a single passage with 4–6 fathoms of water to the south ", but in reality this entrance is a double one, and is very similar in its general features to the entrances to Addu atoll. On the west side of the apparently single entrance and running close to the reef edge and Mafura Island there is a narrow but deep channel, in which the depth of water is 20–22 fathoms ; this is bounded on the east by an elongate reef, running in a N by E direction, that rises to within $2\frac{1}{2}$ fathoms of the surface, but does not actually reach it. To the east of this submerged ridge there is a second wide but shallow passage, with only 3 to 4 fathoms of water at its outer end, but deepening to a depth of 8 fathoms towards the lagoon. This second wide channel is bounded on the east by the reef on which the island of Fehenfura is situated.

A further resemblance to the entrance at Addu atoll is to be found in the quite distinct tendency for the reef to be prolonged inwards into the lagoon on either side of the entrance. Immediately within the entrance there is an isolated reef on either side ; that on the west is shown in the chart given by Stanley Gardiner (1903, p. 377, fig. 90), as well as in the Admiralty Chart, and opposite the middle of the shallow eastern channel there is a second small shoal, with only some $2\frac{1}{2}$ fathoms of water on it, rising from a depth of about 15 fathoms.

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THE OUTER REEF.

In an atoll such as Addu, in which a considerable part of the reef is covered with islands, it is possible to divide the reef into three more or less concentric zones, namely the outer reef flat or boat channel between the reef crest and the islands, the ring of islands, and the inner lagoon reef flat. Such a distinction is, however, only possible in Horsburgh atoll on the north and north-east sides, where a string of islands is still to be found; around the remainder of the reef no such division can be made owing to the complete absence of land from this section of the reef. Stanley Gardiner has tentatively attributed this distribution of the land to the effect of the south-west monsoon that impinges on the south and west sides of the atoll and leaves the north-east part but little affected—a view with which I am in agreement.

Taking the entrance channel as our starting-point, to the west, *i. e.* on the south-west and west sides of the atoll, the reef flat is wide, and extends, without interruption from islands, from the outer margin to the lagoon; there is no very definite lagoon reef, the water gradually deepening to some 20 fathoms as we follow the slope inwards. Only in the vicinity of the entrance channel is there a definite lagoon-reef.

On the north side of the atoll lies a string of three islands, commencing with Inafuri at the north-west point, and continuing with Furadu and Fehendu islands. In this part of the reef the general character of the seaward margin is very different from that in Addu atoll, for here there is no definite "buttress and trench zone", such as is present in the exposed parts of that atoll. The seaward slope from the reef crest is broad, usually about 20–25 yards across, and it slopes gradually down to the reef edge, which appears to drop steeply into deep water, but near the edge the water was too deep for me to be able to make a careful examination. This seaward zone is characterized by a rocky floor from which arise numerous masses of dead coral, while dotted over the reef flat and growing, sometimes on the rock floor and in other places on these dead coral masses, are numerous small colonies of living coral, mostly compact colonies of madrepore (*Acropora*), but interspersed with colonies of *Cœloria*, Astræaceæ, etc. In this part of the reef there seems to be little or no growth of Lithothamnia—a condition that in all probability is correlated with the protection afforded by South Malosmadulu atoll and the consequent absence of a heavy surf. As one proceeds inwards from the reef margin the masses of dead coral become more and more numerous (Pl. I, fig. 1), till they finally blend together into a zone that might well be mistaken for a "boulder zone", but a comparison of this area with the true boulder zone in Addu atoll (Pt. III, Pl. II, fig. 3, *supra*) reveals several differences, and the general structure, especially of the seaward zone, more nearly approaches to the condition that was found to be present in the lagoon reef on the north-east side of Addu atoll (Pt. III, Pl. VII, fig. 1, *supra*), where the main mass of the reef consists of dead and partly eroded coral-rock on which numerous small and usually compact colonies of living coral are growing, and the general features are, I think, to be explained as a result of the death of the old reef, consequent on a change of sea-level, and the subsequent erosion of the dead coral down to a depth at which living coral can again acquire and maintain a foothold. In Horsburgh atoll this "boulder zone" is about 8 to 10 yards across and is fully exposed at low water; it seems to be the remains of the old and dead reef, that has not yet been entirely eroded away, augmented to some and possibly to a considerable extent by the addition of masses of coral that have been uprooted during storms and have been rolled inwards

by wave action, the comparatively weak force of which in such a sheltered area is yet sufficient owing to the lesser consolidation of the reef due to the reduced and almost negligible growth of Nullipore. Some of these masses of dead rock or coral were free, but others had either become consolidated with the basic rocky substratum or else had never been detached from it. Beneath the loose coral masses are to be found small Holothurians, irregular Star-fish, Brittle-stars, Sipunculids, *Thalassema* sp., Crabs of various genera, such as *Leptodius* and *Calappa*, Hermit-crabs, small Fish, and Sponges of various kinds, especially the encrusting forms ; but on the whole the fauna is not a rich one.

Inside this zone, and usually clearly and sharply marked off from it, is a wide reef flat or boat channel, some 150–200 yards across, that is covered at low-water spring tides by about 1 ft. to 18 in. of water in the outer part, though the depth increases somewhat as one approaches the islands that in this part of the reef stand some distance back from the reef edge. In places the change of level from the " boulder zone " to the boat channel is abrupt, forming a small precipice. Along the outer part of the boat channel, just inside this " boulder zone ", there is a belt that is characterized by a profuse growth of living coral (Pl. I, fig. 2) ; in places this growth consists almost entirely of colonies of *Heliopora cærulea*, some of them living but others dead and more or less encrusted with a calcareous deposit, and interspersed among these colonies are other smaller colonies of stag's horn Madrepore and *Pocillopora*, with occasional colonies of Astræaceæ and *Millepora complanata*, these latter being conspicuous by reason of their bright yellow colour ; a fair amount of the calcareous alga, *Halimeda*, is also found here. In other parts of the boat channel the coral growth consists almost entirely of branching stag's horn Madrepore (*Acropora*).

The inner part of the boat channel constitutes a wide flat, the floor of which is composed of rock with a covering of loose sand ; this is largely occupied by burrowing or sedentary animals, among the latter being several large Actinians that, when their tentacles were touched, retracted themselves into holes in the sand about 3 in. in diameter, and examples of the stinging Anemone, *Actinodendron*, were also noticed. Holothurians were comparatively rare, only a few being seen ; but scattered over the flat were colonies of a brownish-yellow Anthozoan (? *Palythoa*) and in places small beds of a brown Tubularian-like Hydroid, while numerous brightly-coloured small fish were to be seen swimming in and out of the coral colonies or darting for shelter beneath the ledges of some piece of dead coral.

At the eastern end of this northern reef flat lies the island of Goidu, and here the so-called " boulder zone " becomes merged in the outer rim of the island. The northern part of this island has been eroded away to form a wide shallow bay, in which the boat channel terminates and large areas of which dry completely at low-water spring tides. At the north-east corner of Goidu Island a spit, composed of rounded coral fragments, runs out from the island and curves round towards the west to become continuous with the " boulder zone " and form the northern boundary of the bay. This spit consists of a basal part of large water-worn boulders, that appear to have been washed inwards across the outer reef flat, and an upper part of smaller fragments with one or two lines of coral shingle. Off the extreme end of the spit on the so-called " boulder zone " are one or two " coral horses ", indicating an earlier extension of the island that has now been washed away. The floor of the bay is composed of sand and mud and is thickly overgrown with a grass-like alga (? *Halophila*), and on one occasion enormous numbers of the

Schyphomedusa, *Cassiopea andromeda* (Forskål) var. *maldivensis* Browne, were found here ; they were all lying on their backs with their tentacles waving in the water exactly in the manner recorded by Stanley Gardiner (1906, p. 962). I attribute the luxuriant growth of the weed in this area to the degree of " manureing " that is taking place, for round the head of the bay is a large fishing village.

At the extreme east end on the atoll the seaward edge of the reef lies close to Goidu Island, but to the south of this island the so-called " boulder zone " again makes its appearance and is exposed at low-water spring tides. Outside this part of the zone the surface of the reef is thickly dotted over with irregularly scattered colonies of growing coral of several kinds, conspicuous among which was a very strong and stout stag's horn coral (? *Acropora grandis*), as well as colonies of *Porites*, *Goniastræa* and *Heliopora cærulea*. This outer zone shelves slowly downwards towards the seaward edge of the reef, over which a slight surf was generally breaking ; along the edge occasional large raised colonies of a species of branching coral were exposed by the back-wash of the waves, but otherwise the reef edge was never exposed even at the lowest states of the tide. Stanley Gardiner, who examined this area carefully during his visit in 1899, informs me that the coral here is for the most part composed of colonies of *Psammocora* and especially of *Montipora*, the former possessing a yellowish colour, while the latter is greyish. Here again there seems to be no " buttress and trench zone ", and the amount of nullipore growth must be insignificant. The so-called " boulder zone " itself here consists of dead and water-worn masses of coral. Inside this zone the reef flat or " boat channel " is covered at low water by 1–1½ ft. of water, and growing on the flat are colonies and masses of living coral of many kinds, among which the " corymbose " type of Madrepore is of frequent occurrence, while small colonies of *Acropora*, Astræaceæ and *Heliopora cærulea* are also present. On the whole the stag's horn type of Madrepore predominates and in places forms large beds, spreading over the surface of the flat towards Goidu Island. The bulk of the reef floor is covered with sand, with occasional lumps of dead and water-worn coral, and a few large yellow Holothurians, as well as some stinging Actinians, *Actinodendron* sp., were seen. To the south of Goidu near the edge of the reef lies a small detached islet, that appears from its position to correspond to the one named Masilokolu on the Admiralty chart. On the " boulder zone " between Goidu and this little islet are one or two coral horses about 1½ ft. in height, that still indicate either the former extension of Goidu Island or the last remaining traces of a second small islet, Raburi.

At the time when I visited the southern portion of the reef the breakers on the outer edge were too heavy to allow me to make a complete examination of the outer zone, but from what I was able to see the seaward margin appears to be very similar to the exposed face of the reef in Addu atoll. Stanley Gardiner (1903, p. 380) states that " the reef flat round the whole atoll is quite similar to that on the west of Minikoi, where no land exists ", and the extreme margin is formed by a definite " buttress and fissure zone ". Inside the breakers in this part of the reef there is a well-marked true boulder zone, consisting for the most part of small masses of dead and water-worn fragments of coral, some of which have been torn off the face of the reef and have been flung inwards by the force of the waves, though others may have been eroded out of the original coral rock. Some of these fragments are lying loose on the reef, but many of them have become consolidated with the reef flat. Many of these masses are plates and stumps of a type of coral that appears to be identical with that seen on the seaward margin at the east end of this atoll, and on

the face of the lagoon reef at the north-east corner of Addu atoll, namely a very stout stag's horn Madrepore with large flat and thick leaf-like branches (? *Acropora grandis*). Small colonies of *Pocillopora*, *Madrepora*, Astræaceæ, *Cœloria*, etc., are growing on the reef flat, but the predominating feature, as usual in an exposed situation, is the growth of *Lithophyllum*. A few patches of *Halimeda* and other Algæ contrive to maintain their position in spite of the to-and-fro wash of the heavy seas, but for the most part the reef is devoid of vegetation. Scattered along the boulder zone are numerous large masses of coral; according to Stanley Gardiner (1903, p. 380), on this part of the reef to the south of the atoll there are " here and there . . . larger rocks appearently due to elevation ", but the only rocks that I found were large masses of coral, smaller, doubtless, than those found on the reefs of the Pacific atolls, but still indubitably meriting the term " negro-heads ". All these coral masses had in my opinion been torn off the reef face and had been flung up on to the boulder zone; the larger masses lay nearest to the breakers, and the distance to which individual masses had been flung appeared to depend, to some extent at any rate, on their shape, for rounded masses of Astræaceæ had been rolled further inwards across the reef, while irregularly shaped masses had come to rest sooner and, therefore, are now nearer the breakers. I could detect no evidence of elevation in this part of the reef, though there is ample evidence of this in other parts of the atoll, and the whole structure of this region seems to me to be attributable to wave-action and erosion. Stanley Gardiner (1903, p. 377) remarks that " a line of coral rock and two islets to the west of Goidu, together with a series of masses on either side of the passage, prove elevation. A certain number of coral pinnacles, running from Goidu westward in the boulder zone of the reef as far as the passage, indicates that the elevated land once probably extended along the whole south side of the atoll ". Although I could detect no actual evidence of previously existing land on this southern section of the reef, I am in entire agreement with the view that land was formerly present here; but it seems to me that the destructive activity of the south-west monsoon and marine erosion have now completely destroyed the last traces of it; and in this connection it must be remembered that it is exactly this section of the atoll rim that feels the full effect of the south-west monsoon winds and seas. The larger negro-heads, some of which are from 3–3½ ft. in height and from 3–4 ft. in diameter, were in my opinion derived from the reef margin; they lay in any position, many of them being upside down, and were, I am convinced, neither resistant masses of coral rock, nor colonies of coral still *in situ*.

Inside the boulder zone in this part of the reef there is a wide expanse of reef flat, extending uninterruptedly to the edge of the lagoon reef. Immediately inside the boulder zone the flat is thickly covered with colonies of growing coral, for the most part of stag's horn Madrepore, with numerous small scattered colonies of *Pocillopora*, Astræaceæ, etc., and a few scattered *Fungia* and small colonies of *Heliopora cœrulea*. As one follows the reef flat inwards, this growth of coral gradually thins out and the surface of the reef becomes an extensive sand flat, with here and there patches of stag's horn Madrepore, until one reaches the lagoon reef.

THE ISLANDS OF THE REEF FLAT.

As is frequently the case in these atolls, there is on either side of the entrance channel a small rocky islet, that on the west side called Mafura and that on the east Fehenfura. Regarding these Stanley Gardiner (1903, p. 379) states that " they are formed of coral

rock. . . . They represent the same line of rock that occurs to the east of Goidu, and, if clothed with vegetation, would be not dissimilar to Raburi and Masilokolu ". Mafura is composed, at any rate in its upper part, of coral fragments, broken and water-worn and black in colour ; and this black colour of the fragments suggests that they are not fresh coral masses torn off the reef, but are old masses that have been eroded out of the reef rock and have been subsequently piled up in their present position. There is in all probability beneath these loose fragments a basic stratum of rock, on to which the coral fragments have been flung in much the same manner as they have been flung up in the island of Mulikadu at the south entrance of Addu atoll (Pt. III, Pl. IV, fig. 1, *supra*).

The chief island in the atoll, Goidu, that is situated on the extreme north-eastern part of the reef, still retains what was probably its original position on the " boulder zone ". Along the seaward face the island is raised some 3 or 4 ft. above the general level of the rest of the island by a wide bank of coral boulders and shingle, mixed with a certain amount of vegetable mould and debris, that is thickly overgrown with trees and bushes. The rest of the island is flat and consists of sand ; it is thickly wooded in the eastern part, but towards the north-west area this thick vegetation thins out somewhat and is replaced by a bush scrub and numerous palm trees. The seaward face of the raised outer margin, which appears to correspond to the " hurricane-beach " of other atolls, though its general features are now somewhat obscured owing to the thick vegetation and the consequent formation of mould, drops steeply for a short distance and then slopes more gradually down to the water level, where it blends with the reef flat (Pl. II, fig. 1). The boulders and coral fragments forming the outer rampart are rounded and water-worn, and appear to be very similar to the water-worn boulders that form the basal part of the spit that runs out towards the north along the so-called " boulder zone " at the north-east corner of the island (*vide supra*, p. 112).

The sloping part of the beach above sea-level consists entirely of a wide expanse of coral rock with scattered patches of loose sand, and here and there are scattered larger blocks of conglomerate that were clearly at one time part of the raised margin of the island, but which, owing to erosion, have now been separated from it. It appears certain that a slow but steady erosion is going on and that the island is being gradually driven back from the boulder zone, though the degree to which the atoll is sheltered from the full force of the north-east monsoon by the atolls of the eastern series has much delayed the process ; there is, however, clear evidence of erosion in the presence of fallen trees and shrubs along the beach. Just inside the raised rim is a small lake (kuli), now nearly filled up and much overgrown by bushes, rushes, etc. ; around its margin were several examples of the crab *Cardiosoma carnifex* (Hbst.), and these have also honeycombed the inner side of the raised rim with their burrows. In the jungle examples of *Geograpsus grayi* (M. Edw.) are to be found.

On the south-east side of the island there is a wide bay, the northern horn of which is formed by the southernmost part of the raised rim that is continued southwards for a short distance along the " boulder zone " as a spit of coral fragments and shingle. Beyond this to the south there is on the reef flat a group of coral horses and then comes a small islet. These coral horses probably denote a previous extension of the main island, Goidu, the intervening area having since been eroded away. At the time when Moresby made his original survey of the atoll there were two small islets in this position, named respectively Raburi and Masilokolu ; both of these are still shown on the chart given by Stanley

Gardiner (1903, p. 377, fig. 90), and were there at the time of his visit in 1899, though he informs me that Raburi was then only a small mass of rocks awash and without any vegetation; by 1902, when Agassiz paid his visit to the atoll, this latter island had disappeared, for he remarks (1903, p. 54) that "the southern extremity of Goidu Island appears to be wasting away; a small adjoining island marked on the chart has disappeared." At the time of my visit in 1934 there was only a single islet in this part of the reef, which from its position seems to correspond with Masilokolu, and this too was clearly being eroded away. The outer rampart of coral rock has been breached and much of it has disintegrated, though the more solid part of the rim still resists erosion and is being converted into coral horses (Pl. II, fig. 2), that stand up about 1–1½ ft. above low-water level. Between these raised masses and the present sea-face of the islet is a flat area of boulders, just awash at low water and passing gradually into the island beach, that on the north-east side consists of a coarse coral shingle, but on the south side is still composed of larger water-worn coral boulders. All around the sea-face of this islet are fallen trees and shrubs. On its inner or western face the islet consists of a flat area of shingle that is devoid of trees and bushes and appears to be of quite recent origin; this slopes downwards to the level of the reef flat, and spreading inwards across the reef flat from the islet is a spit of sand with a margin of coral shingle to both north and south of it, that on the south side being considerably the larger (Pl. III, fig. 1). There can be no doubt that this islet also is rapidly undergoing erosion and will before very long have been completely disintegrated. The small patch of coral horses between Goidu and Masilokolu (Pl. II, fig. 2) may, perhaps, be the last remaining traces of the islet of Raburi. Around the northern part of the bay Goidu Island is also being eroded; trees and shrubs have been killed and have fallen on the beach. Scattered along the beach are eroded masses of coral rock, and at one point the land has fallen away, leaving a small cliff, some 3 ft. in height, in which one can recognize an upper stratum, about 1 ft. 3 in. in depth, of brown mould and roots of trees, and below this is a horizontal layer, about 1 ft. thick, of sandstone. Still further to the south on the south-east side of the island one comes to an area in which the land appears to be extending; here the line of the shore bends outwards towards the reef flat, and between the thick jungle, with which this part of the island is covered, and the sea beach there is a margin of flat sandy ground that is covered only with low shrubs and saplings. Along the upper part of the beach in this area is a line of small pumice fragments. If we assume that these fragments were originally derived from the explosion of Krakatoa in 1883, it is highly unlikely that they were shortly afterwards thrown up in this part of the beach, as seems probably to have been the case on some of the lagoon beaches in Addu atoll; it is still less likely that they could have been deposited here after some earlier eruption, and it is more probable that this is a comparatively recent deposit of old fragments that were originally flung up on some other part of the island, and that during the process of erosion they have been displaced and have been re-deposited in the present situation. On the north side of Goidu, behind the spit of coral boulders that runs out on to the reef flat, the island, as already pointed out, has been eroded away to form a wide bay. As one walks westward along the shore of this bay towards the north-west corner of the island one sees numerous outcrops of beach-sandstone, and the beach, which otherwise is composed of sand, slopes upwards towards the island and terminates in a small cliff, about 2 ft. in height. Along this part of the island there is no raised rim; the land is

flat, and is covered with a bush scrub and plantations of palm trees. Near the north-west corner of the island there is an area of the beach that is traversed by a number of roots of trees, running out from the island into the sea, and on the west side of this area is a small sand spit that forms the extreme north-west corner of the island. Immediately round the corner on the west side there is again an outcrop of beach-sandstone, and along the southern part of the west beach and at the south-west corner of the island an extensive exposure of the same formation is to be seen. There can be little doubt that on the whole the island is steadily being eroded away and, although there may be a small gain from time to time in one or other part of the island, the main change seems to be one of loss.

On the northern part of the atoll rim to the west of Goidu, but separated from it by a wide shallow channel, lies the island of Fehendu. This island lies a long way in from the reef margin and is long and narrow, especially near the middle of its length, so that it exhibits a very elongate figure-of-eight or " dumb-bell " shape. It is thickly wooded, and on its eastern half is situated a large village. The east end of the island shows clear evidence of erosion ; at the south-east corner there is an outcrop of rock, that borders the southern or lagoon shore of the island, and is continued on for some 15 yards as a reef that continues the line of the shore and runs eastward towards Goidu Island. At the north-east corner of the island there is a sand spit that also runs eastward ; so that between the rock reef and the sand spit there is formed a small bay, the floor of which is for the most part sandy, but which is dotted over with scattered boulders and slabs of sandstone. Above the beach the island here terminates in a cliff that exhibits the structure that one so frequently finds in these coral islands, namely an upper stratum of brown vegetable mould and tree roots, about 1 ft. 3 in. in depth, below which there is a thin layer of loose white sand ; and then below this again comes a horizontal stratum of sandstone, about $1\frac{1}{2}$ ft. thick, below which the sand is again soft. One cannot but conclude that the slabs of sandstone in the small bay have been derived from the erosion and undermining of the sandstone stratum of the island. Along its northern side the island is edged with a sloping sandy beach, at the foot of which near low tide mark there is for long stretches a belt of coral rock ; but about the middle of the length of the island and opposite its narrowest part this rock belt has been breached, and much of the land has been eroded away to form a wide bay (Pl. III, fig. 2). It is very interesting to note that Stanley Gardiner makes no mention of this bay in his account of the island. At the time of our visit it formed a very noticeable feature and, combined with a corresponding bay on the south side of the island (*vide infra*, p. 119), the effect has been very nearly to divide the island into two parts. It is possible that at the time of Stanley Gardiner's visit in 1899 there was no such bay ; erosion on the seaward face appears to have proceeded here with remarkable rapidity, for the Head Man of the atoll, who seemed to be a very intelligent individual, informed me that when he first came to the atoll, now some twenty-three years ago, and eleven years after Stanley Gardiner's visit, this now very narrow neck of land separating the seaward and lagoonward beaches and connecting the two ends of the island was about 40 yards wide, whereas at the time of my visit in 1934 it was only some 4–5 ft. in width.

Along this eastern part of the island and round the shores of the bay the beach is sandy and slopes up gradually to the level of the island ; at low tide numerous rays come close inshore, and, covering themselves with sand so that they are almost unrecognizable, lie basking in the warm water. Along the eastern half of the bay and the neighbouring

part of the northern beach there are several bushes now standing well out on the beach between tide-marks, and the outermost are already dead or are in the process of becoming so. On the west side of the bay the shore runs straight out towards the reef flat and terminates in a short rock reef that runs eastward along what must have been the old shore line, and that is clearly a direct continuation of the original rock margin that still borders the seaward face of the western half of the island. At this point erosion has been active, as is shown by dead and fallen trees on the beach ; here the beach consists of a sloping outcrop of coral rock, above which there is a narrow shelving area of loose sand, and then comes a sheer cliff, about 4 ft. in height, rising to the level of the island (Pl. IV, fig. 1). An excavation was dug into the face of this cliff in order to expose the strata, and here again we can distinguish the same strata that we found on Goidu Island and at the eastern end of Fehendu. The upper 18 in. consist of soil and the roots of trees, etc. ; then comes a layer of loose white sand of about the same depth, below which there is a band, running horizontally in conformity with the general level of the island, of sandstone of a greenish colour and about $1\frac{1}{2}$ ft. in thickness ; below this sandstone there is again a stratum of loose white sand down to the level of the top of the beach. The layer of sandstone exposed in this cliff is almost certainly continuous throughout the whole of the island, for near the village at the east end of the island a well has been dug, and the strata exposed in the process agree exactly with those seen in the face of the cliff ; on the surface there is a stratum about $1\frac{1}{2}$ ft. thick of soil and vegetable mould, and below this comes a layer of compact white sand ; below this again the sand becomes harder and was dug out in lumps, which, however, were not sufficiently consolidated to be termed sandstone, since the lumps could be crushed by hand. This stratum was succeeded by a second layer of loose sand, and then came the rock basis of the island, the old coral rock. It seems probable that in this instance the sandy layer was in the process of undergoing consolidation and in time would have hardened to a true sandstone—a process that would probably be expedited by exposure to the air or spray from the breaking waves on the shore, as in the case of the outcrop on the cliff face.

To the west of the bay the northern margin of Fehendu island is characterized by an almost continuous outcrop of dark grey rock that has been eroded on its seaward face to form a small irregular cliff (Pl. IV, fig. 2) ; the upper surface of this rock ledge has been weathered into numerous holes and pinnacles, but its general level slopes gradually downward towards the island, and here too in places there is a small cliff, where the inner part of the rock ledge has been eroded away by sea action. Finally this rock outcrop disappears beneath the sandy upper part of the beach, which slopes upwards towards the island margin, and at the top of this beach there is a second outcrop of rock, the exposed margin of the sandstone stratum that has been formed beneath the sandy part of the island. In his account of this island Stanley Gardiner (1903, p. 378) remarks : " To the north or seaward side the whole shore is studded with lines of beach sandstone which generally are separated by areas of loose sand. Often, however, the lower terraces lie on the sand flat quite beyond the slope of the beach ; in one place eight separate terraces having been found." For a long time I found it a matter of great difficulty to reach a decision regarding the exact nature of this grey rock along the beach, and I was myself at first inclined to regard it as beach-sandstone, but the general character of the rock, that is composed of a very hard matrix in which are embedded fragments of coral, *Tridacna* shells, etc., is very different from that usually found in a beach-sandstone, and I am convinced that it is in

reality a part of the old raised reef flat, that since its elevation has been protected by the sand of the island, and is now being gradually exposed and eroded along its seaward margin by the combined action of rain and marine erosion. In addition to the breach opposite the bay referred to above, there is another point on the northern side of the west part of the island where this outer rampart of rock has been breached, and here there is now a smooth glacis of rock extending up to the edge of the jungle; while for some distance along the edge of the jungle at this point are broken-off masses of sandstone, that appear to have been derived from the horizontal stratum of sandstone that has formed beneath the surface of the island and to which I have already called attention (*vide supra*, p. 118). At the west end of the island on the north side a very considerable change appears to have taken place during the past thirty years, for Stanley Gardiner in his account (1903, p. 378) states that "at the extreme west point a sand spit stretches out for 50 yards, with a number of sandstone masses along its seaward face and off its end, showing that the island must have at one time extended considerably further along the reef". At the present day the tide sets off the outer reef flat round the west end of the island into the lagoon in a strong current that is continually wearing away the sandy beach, that at this point now runs out in a small promontory; off this spit there is a channel, 5–6 ft. in depth, the floor of which is dotted over with small colonies of growing coral, mostly Madrepore. Lying some distance off the end of the spit on the other side of the channel but in the continuation of the main line of the island is a small sand cay with a few rock boulders. On the south side of the island the beach is, in the western part, composed of a smooth "glacis" of rock (Pl. V, fig. 1), extending from just above high-tide level to low-water mark; at the low-tide level this outcrop of rock ends in a small but steep and irregular cliff, about 1 ft. in height, that along its margin presents a number of small gullies, reminiscent in miniature of a "fissure zone". Along the high-water level the rock is eroded into holes and pinnacles, exactly as is the rock of the seaward face of the island. Above this rocky outcrop lies a strip of sandy beach that slopes up to where the vegetation of the island begins. This rock, like that on the outer or seaward face, I take to be part of the old reef rock, that was formerly covered by the sandy part of the island and that has now become exposed and is being steadily eroded away. About the middle of the island, opposite where the bay has been formed on the northern face, there is a corresponding shallow bay on the south side. Along the shore of this bay in its central part there is an exposure of rock, the origin of which is somewhat difficult to determine; on the lower slope of the beach between tide-marks there is an exposure of dark grey rock that is much eroded, and presents several layers or strata that slope downwards towards the lagoon, and this I take to be a continuation of the similar rock that fringes the northern face of the island and forms the smooth glacis along the western half of the lagoon side; but above this near the top of the beach there is a second outcrop of rock in which the slope seems to be downwards towards the north and thus away from the lagoon. This latter rock is also somewhat pitted on its upper surface, though not as markedly so as the old rock of the seaward side, and appears to be composed of several strata (Pl. V, fig. 2). I am of the opinion that this is not the same rock as the lower rock exposure on the northern beach or the glacis of the lagoon margin, but is a part of the sandstone basis of the island that has been consolidated beneath the "reverse" slope of the lagoon mound, and has subsequently become exposed by the erosion of the lagoon side of the island; it is, in this connection, interesting to note that, although there is no

trace of any lagoon mound along this part of the south beach, a little further to the east there is a distinctly raised rim along the island face.

To the west of Fehendu there is a wide interval and then comes the island Furudu, off the eastern point of which there are several sand cays. Furudu is fairly thickly wooded, especially in its eastern part, where there are a number of large trees, as well as smaller bushes; but the western part is in the main covered with a bush scrub. At the extreme east end the island is produced in an S-shaped sand spit that runs out from the island in an easterly direction and is covered for about half its length by a line of low bushes, but beyond this there is only bare sand. In this eastern part of the island both north and south beaches are shelving, and there is no raised rim to the island. The whole of this part of the island is clearly being eroded away, and in one or two places there is an exposure of the horizontal sandstone basis of the island; one such exposure is well seen near the village and there are several more towards the west, in which the sandstone stratum has been clearly undermined, the soft sand beneath it having been washed away. This sandstone stratum is seen to be about $1\frac{1}{2}$ ft. in depth, and lies below a layer, some 2–3 ft. thick, of soil and vegetable mould. In places this stratum consists largely of fragments of broken coral, mainly of either the stag's horn or the "corymbose" type of Madrepore, intermixed with shells, among which was a species of *Oliva*; such a composition suggests that the conglomerate has been derived from the consolidation of sand and coral fragments, such as might originally have been thrown up and have formed part of the reef surface or a sandy beach before the relative elevation of the land took place. Below this outcrop of sandstone there is a sloping sandy beach that terminates below in a wide expanse of solid grey rock, which further to the west forms a raised rim similar to that seen in Fehendu Island. The surface of this lower stratum is weathered and pitted, and the strata of which it is composed can be seen to slope downwards towards the island and away from the ocean face of the atoll. Stanley Gardiner (1903, p. 379) has called attention to this outcrop: "Perhaps the most noticeable point about Furudu lies in its beach sandstone to the north being but little terraced. It presents in many places a cliff of 2 or 3 ft. to the sea with one solid mass of rock behind. . . . The sea has not overtopped the sandstone, and its removal must be by the undermining action of the water, both erosion and solution, just as a pinnacle of coral rock is worn away." In places this grey rock contains fragments of coral, and in one place I found a colony of stag's horn madrepore upright, *in the natural position of growth*, and in a remarkable state of preservation, the calices being little, if at all, worn; there can, I think, be little doubt that this rock is not beach sandstone, but is part of the old reef rock that is now being eroded away. Towards the western part of the island the sea has eroded a considerable part of the north face of the island, so that here too a shallow bay has been formed; and between this bay and the outer reef flat there is a line of rock running obliquely across the reef flat towards the west as far as the so-called "boulder zone" (Pl. VI, fig. 1). At its extreme end and on its seaward face this rocky promontory terminates in a vertical cliff; the rock is clearly composed of a solid stratum that slopes downwards towards the south and away from the reef flat. In places, and especially along the crest, the upper surface of the exposure has weathered, like the rocky outcrop along the sea beach, into pinnacles and holes; but the greater part of the exposure and especially the landward slope is smooth, though traversed by channels, and in places worn into pot-holes in which small pools of water are left by the receding tide. Here again there is some difficulty in reaching

a decision regarding the exact nature of the rock. Is it part of the coral rock of the old raised reef flat ? Or is it an exposure of sandstone, that has been consolidated beneath the " reverse " slope of the seaward margin of the island and has subsequently become exposed by a process of erosion ? I think that one must decide in favour of the former origin. In the shallow water on either side of this rock promontory are several circular masses of *Porites* and numerous colonies of *Heliopora cœrulea*, with occasional patches of *Halimeda*. In a number of instances the upper surface of these *Porites* colonies has been completely killed off, the process being due to or at least accompanied by a deposition of calcium carbonate, the only part of the colony that is still living being the outer margin (Pl. VI, fig. 2). On the inshore side of the promontory the floor of the reef flat is composed of slabs of rock beneath which and partially concealed lie numerous black Holothurians (*Holothuria atra* ?), many of them harbouring a black Polychæt worm, *Polynoe* sp., and numerous Brittle-stars. Along this rock outcrop, as also along the face of the rock outcrop on Fehendu Island, are numerous green grapsoid crabs, *Grapsus grapsus* (Linn.) and *Grapsus strigosus* (Herbst.), and, as the tide rises, small eels and occasionally a small octopus can be seen moving along the face of the outcrop in search of these crustacea. Proceeding westward towards the extreme west end of the island the shore is for the most part composed of a smooth slope of pure sand that is frequented by Ocypode crabs, *Ocypoda ceratophthalma* (Pallas) Ortmann, and is also a favourite locality for turtles that come up to lay their eggs. In one part there is a small outcrop of true beach sandstone between tidemarks, and this is haunted by a number of examples of *Onchidium* sp. The extreme west end of the island forms a long sandy spit, that terminates in a steep slope, off which there is a comparatively deep channel, some 6 ft. in depth. On the south side of the island the land near the west end appears to have been increasing within recent times, for here there is a narrow strip, about 5–6 yards wide, and some 300 to 400 yards in length, that is covered with a species of grass and is dotted over with saplings ; while behind this belt the island is covered with a thick jungle. This recently added strip, however, terminates on its lagoon face in a small cliff, about $1\frac{1}{2}$ ft. in height, that drops to the sandy beach, and this has undoubtedly been formed by a still more recent process of erosion. Opposite the central part of the island there is at the top of the beach a cliff of about the same height, with fallen trees and the exposed roots of others ; and here a line of rock runs along the inner reef flat parallel to the beach and about 30 yards out from the shore. Further to the east the level of the island again terminates in a small cliff, but in this part only about 9 in. in height, and below this is a sloping beach of fine sand, with here and there small outcrops of rock, but not a continuous ridge such as one finds on the northern face ; on the beach were numerous hermit crabs, the cuttle-bones of *Sepiella indica*, shells of *Spirula*, *Pinna squamifera* and other mollusca, mixed with fragments of coral and *Tubipora musica*. Towards the east end of the island near the village there stands on the lagoon beach a large mass of dead coral that is clearly *in situ* ; it is about $2\frac{1}{2}$ ft. in height and its top is dome-shaped. The upper surface shows little or no sign of wear or weathering, and one would infer from this that it became covered, while still alive, or only very recently after death, by the sand ; the freshness of the septa and the absence of erosion of the calices of the upper surface also suggest that its re-exposure must have been comparatively recent. This coral mass, like a ship's bollard, is embedded in the present sandy beach but is actually a part of the rock sub-stratum, that appears as an outcrop on the beach a few yards further to the east of it, so

that the mass would appear to have been a part of the original reef flat on which this mushroom-shaped coral pinnacle was growing before an alteration of sea-level raised it above the water-line.

To the west of Furudu lies the small island of Inafuri. This has a structure similar to both Fehendu and Furudu ; and between Furudu and Inafuri are a number of scattered sand cays.

THE INNER REEF FLAT.

The general character of the inner reef flat and the lagoon reef differs markedly in different parts of the atoll. On the west side, where the atoll rim is devoid of any traces of land, the lagoon floor drops from about 2 fathoms down to a depth of 5–7 fathoms, and beyond this the depth slowly increases to 20 fathoms at a distance inwards of about 1600 yards, the 10-fathom line being nearly mid-way between the reef and the 20-fathom line.

On the north side of the lagoon inside the islands Furudu and Fehendu the floor of the reef also slopes down gradually. As one proceeds towards the lagoon from the island beaches the floor of the reef is at first composed of sand, but, as one gets away from the islands, colonies of coral begin to make their appearance and get gradually more numerous. These coral heads get larger and larger until they constitute an area of " foul ground ", which is closely dotted over with shoals and patches of coral that rise from a depth of about 6 fathoms almost up to the surface. The character of the lagoon floor also undergoes a change : in the inshore region it consists of a somewhat coarse sand, but as we proceed deeper towards the centre of the lagoon the deposit becomes almost a coral mud, mixed with the remains of pteropods, larval molluscs, spicules of Alcyonarians, etc. Along the lagoon margin of this area of foul ground from Inafuri to a point opposite the middle of Furudu island there is an interrupted reef, that is covered with growing coral and that in many places nearly, though never quite, reaches the surface. On the lagoon side of this reef the depth increases suddenly to some 15 or 18 fathoms. The general character of the corals in this area shows a clear transition ; on the lagoon reef and in the neighbouring zone of the foul ground are masses of *Porites*, *Cœloria*, Astræaceæ, and a very stout form of branching madrepore (? *Acropora grandis*) ; in the intermediate zone we find Astræaceæ, Madrepore colonies of the " corymbose " type, *Pocillopora*, etc., while in the inshore region, where the bottom is for the most part sandy, there is little except the ordinary stag's horn Madrepore, interspersed with an occasional mass of *dead* Astræaceæ. Even in the deeper shoals much of the coral is dead ; in a colony of stag's horn Madrepore the basal stalks and the proximal parts of the main branches are usually dead and encrusted with small colonies of Lithothamnion, Sponges, etc., while only the smaller terminal branches are still living.

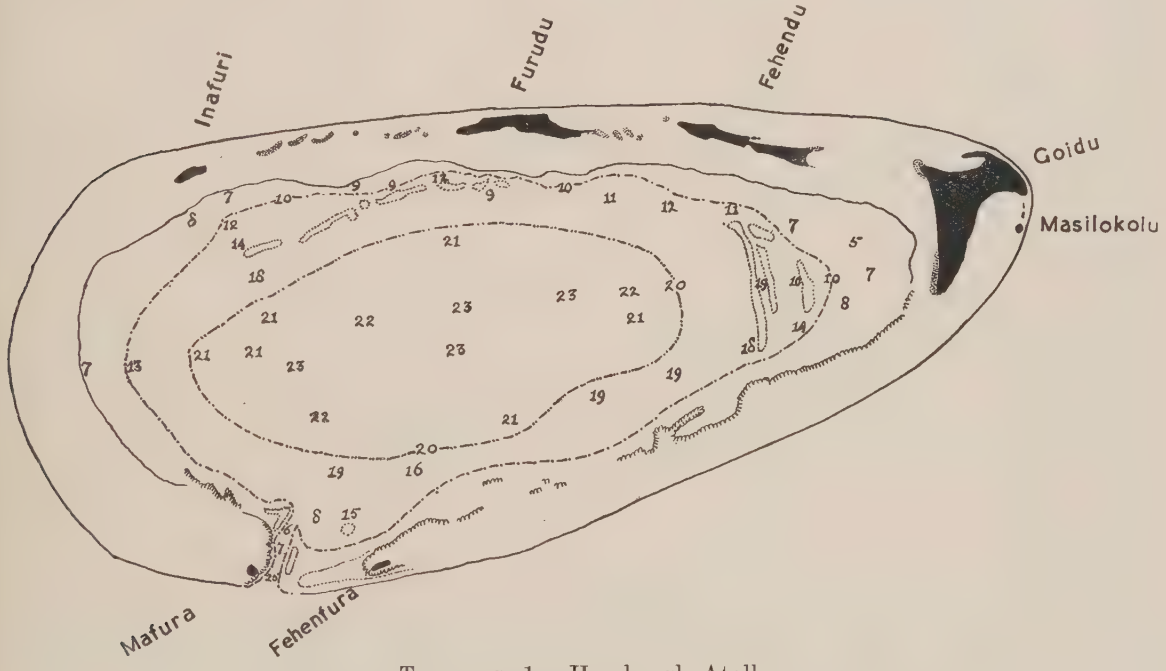
Opposite the eastern end of Furudu and the west end of Fehendu Islands this reef is absent, but on the east side of the lagoon opposite Goidu Island the inner reef flat again presents much the same general character, though here, instead of a single line of interrupted reef, there are no less than three, running more or less parallel to one another, and rising from a depth of some 12–16 fathoms up to 5 to 7 fathoms and in places almost to the surface. As one approaches the west side of Goidu island these reefs are succeeded by an area of foul ground that ultimately is replaced by a wide sand flat, over which the water gradually shoals from about 10 fathoms near the reef to the island beach. In one

area of this flat near the north-east corner of the lagoon there were large numbers of a large yellow Holothurian, about one in every two square yards ; the rest of the flat was dotted over with the ejected sand piles of some burrowing organism.

On the south side of the lagoon, where there are no islands, a typical lagoon reef is present in the greater part of its length, and rises steeply from a depth of some 8 fathoms to within about $2\frac{1}{2}$ fathoms of the surface, after which it shoals up gradually to the level of the reef flat ; in this part the reef presents most of the characters that we have seen to be present in the lagoon reef in Addu Atoll. A little to the east of a point midway between the south end of Goidu Island and the entrance channel a long spit of the reef runs almost due east, parallel to the main reef, but separated from it by a bay in which the water has a depth of about 9 fathoms. In this region the reef rises close up to the surface and is thickly covered with numerous colonies of Madrepore of the " corymbose " type, while off the end of the spit are several smaller isolated patches of the reef of the same type. Even in this reef, however, there is an area lying between the part just described and the entrance channel, where consolidation of the lagoon reef appears to have been incomplete. Here the reef, which is well defined on either hand, is interrupted, only isolated patches being formed, and in the same zone the 10-fathom contour line exhibits a very clear bend inwards towards the centre of the lagoon.

THE LAGOON.

As already pointed out, there are segments of the lagoon margin in which the lagoon reef is incomplete, and the lagoon floor shoals gradually upwards to the margin. Stanley Gardiner (1903, p. 377) gives it as his opinion that " the lagoon is increasing at the expense



TEXT-FIG. 1.—Horsburgh Atoll.

of the encircling reef ". A study of the chart of the atoll (Text-fig. 1) shows very clearly that around the west and south sides of the atoll there is a complete absence of land, so that, if we accept the view that there was a general fall in the sea-level some 4000 years

ago, and that this brought the atoll reef above the water line and thus created an almost complete land rim round each atoll, we must also conclude that on these sides of Horsburgh atoll this land rim has now been completely destroyed, the only land now present in this half of the atoll circumference being the two islets, Mafura and Fehenfura, that lie on either side of the entrance channel and are, at any rate in the main, of secondary formation. Furthermore, it is only along the greater part of this segment of the atoll that we find any definite lagoon reef on the inner side of the reef flat.

Around the north and east segment of the atoll we still have a chain of land masses and sand cays, a scattered remnant of the original land ring that was once, in all probability, continuous ; and there is clear evidence that, although around this arc erosion has not yet been completed, this process is steadily going on in each of these islands. It is around this north-east segment of the lagoon that we find an area of " foul ground " that shelves gradually up to the island beaches and that is bounded on its lagoon side by an interrupted reef, rising from a depth of some 10 fathoms or more and crowned with living coral colonies ; furthermore, it is extremely interesting to see that at the south-east side of the lagoon this " foul ground " and its inner reef lies well within the present line of the true lagoon reef. I have already pointed out that in the north-east corner of Addu atoll the process of erosion of the islands appears to have been accompanied by an extensive deposition over the lagoon reef of sand and mud, the result of which has been to cause a gradual destruction of the original lagoon reef and the formation of an area of " foul ground " ; it seems clear that an exactly similar process is and has been going on in Horsburgh atoll, and the conclusion that the absence of a true lagoon reef is, at least in part, directly attributable to the erosion of the land seems to be irresistible. As a result of such erosion sand and mud will be swept inwards with each rise of the tide, and will be deposited over the living corals and Lithothamnion, if any be present, that are growing on the reef surface ; at the same time another effect of the presence of islands and land masses will be to hold up the water over the outer reef flat during the fall of the tide, so that this will undergo a rise of temperature and a consequent increase of evaporation and rise of salinity. On two occasions I took samples of the surface water in three localities on or near the reef for the purpose of comparison, and the results obtained are given below :

Position	Middle of boat channel, N. of Fehendu Is.	Middle of lagoon reef flat, E. of Fehendu Is.	Lagoon, NE. area.
Depth	2 ft.	2 fathoms	10 fathoms
Salinity (*a*)	35·79	35·70	35·70
,, (*b*)	35·23	..	35·03
Temperature	36·5° C.	..	30·5° C.

Such a marked rise in the temperature of the water over the reef flat would certainly have a deleterious effect on the growing coral colonies, while simultaneously, owing to the stagnation of the water on the reef flat during slack water, there is produced, in all probability, a marked deficiency in the oxygen content of the water, though of this I have no direct evidence.

At the extreme west end of the lagoon, where the atoll is exposed to the full force of

the south-west monsoon, we find an absence of land and yet a complete absence of a definite lagoon reef; at first sight this might be thought to disagree with the view expressed above; if, however, one remembers that the deposition of sand and mud on the inner reef flat and the lagoon reef must, owing to the position of the islands that are now undergoing erosion, *i. e.* on the north and east sides of the atoll, mainly occur during the north-east monsoon and, therefore, will be taking place on the south-west side of the site of erosion, the absence of a true lagoon reef on the west side of the lagoon can be correlated with the erosion that is now going on in Inafuri and Furudu Islands and in the reef between them, where there are still a number of sand cays that have not yet been completely swept away.

Another interesting feature of the lagoon that is clearly brought out in the chart is the manner in which the floor gradually slopes upwards from the centre of the lagoon to the reef. In the central part the depth of water is some 23 fathoms, but around the whole circumference the 20-fathom line lies well inside the 10-fathom line, the average distance separating them being, throughout the greater part of the circumference, about half a mile. It is thus clear that the bottom of the lagoon is in this case far from being flat and is actually basin-shaped. This is especially well shown in a section from west to east along the major diameter of the atoll.

Stanley Gardiner (1903, p. 377) remarks that, so far as the published charts indicate, the lagoon "is singularly open, no trace of coral growth, except near the encircling reef, nor of shoaling being anywhere found"; certainly no shoals approach sufficiently near the surface for their presence to be indicated by a change in the colour of the overlying water, but the very small number of soundings that are shown are quite insufficient to warrant the assumption that there are no shoals to be found anywhere.

The bottom deposit over the greater part of the lagoon floor consists of a soft light grey or cream-coloured mud. A sample of this was collected near the centre of the lagoon and was submitted to the Geological Survey of India for examination. The report on this sample is as follows: "Examination by the petrological microscope shows that the specimen forwarded by you is a crystalline aggregate and not amorphous. Boiling for a few minutes with cobalt nitrate shows that at any rate a good deal is aragonite. The specific gravity is, however, low—2·75. But from the nature of the specimen too much reliance need not be placed on this result. It is probably either a mixture of aragonite and calcite or mostly aragonite. The specimen has been analysed and found to contain 0·26% SiO_2." Large samples of the bottom were obtained by means of the grab in both the north-east and north-west parts of the lagoon, and it is interesting to note that the sample from the north-west area contained an appreciable quantity of sulphuretted-hydrogen gas, the proportion being 7·73 mgrm. per litre in the occluded water that was withdrawn from the sample by aspiration.

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DESCRIPTION OF PLATE I.

FIG. 1.—Outer zone of reef flat opposite Fehendu Island.
FIG. 2.—Inner zone of reef flat opposite Fehendu Island.

FIG. 1.

FIG. 2.

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DESCRIPTION OF PLATE II.

FIG. 1.—Seaward beach on east side of Goidu Island.
FIG. 2.—Seaward face of Masilokolu Island.

FIG. 1.

FIG. 2.

[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE III.

FIG. 1.—Inner beach of Masilokolu Island.

FIG. 2.—North beach of Fehendu Island, looking east.

FIG. 1.

FIG. 2.

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DESCRIPTION OF PLATE IV.

FIG. 1.—Excavation in cliff face to show sandstone stratum.
FIG. 2.—North beach of Fehendu Island, looking west.

FIG. 1.

FIG. 2.

[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE V.

FIG. 1.—Lagoon beach on west end of Fehendu Island.
FIG. 2.—Sandstone outcrop on lagoon beach of Fehendu Island.

FIG. 1.

FIG. 2.

[*Adlard & Son, Ltd., Impr.*

DESCRIPTION OF PLATE VI.

FIG. 1.—Outcrop of coral rock on north side of Furudu Island.

FIG. 2.—Coral growth on outer reef flat opposite Furudu Island.

FIG. 1.

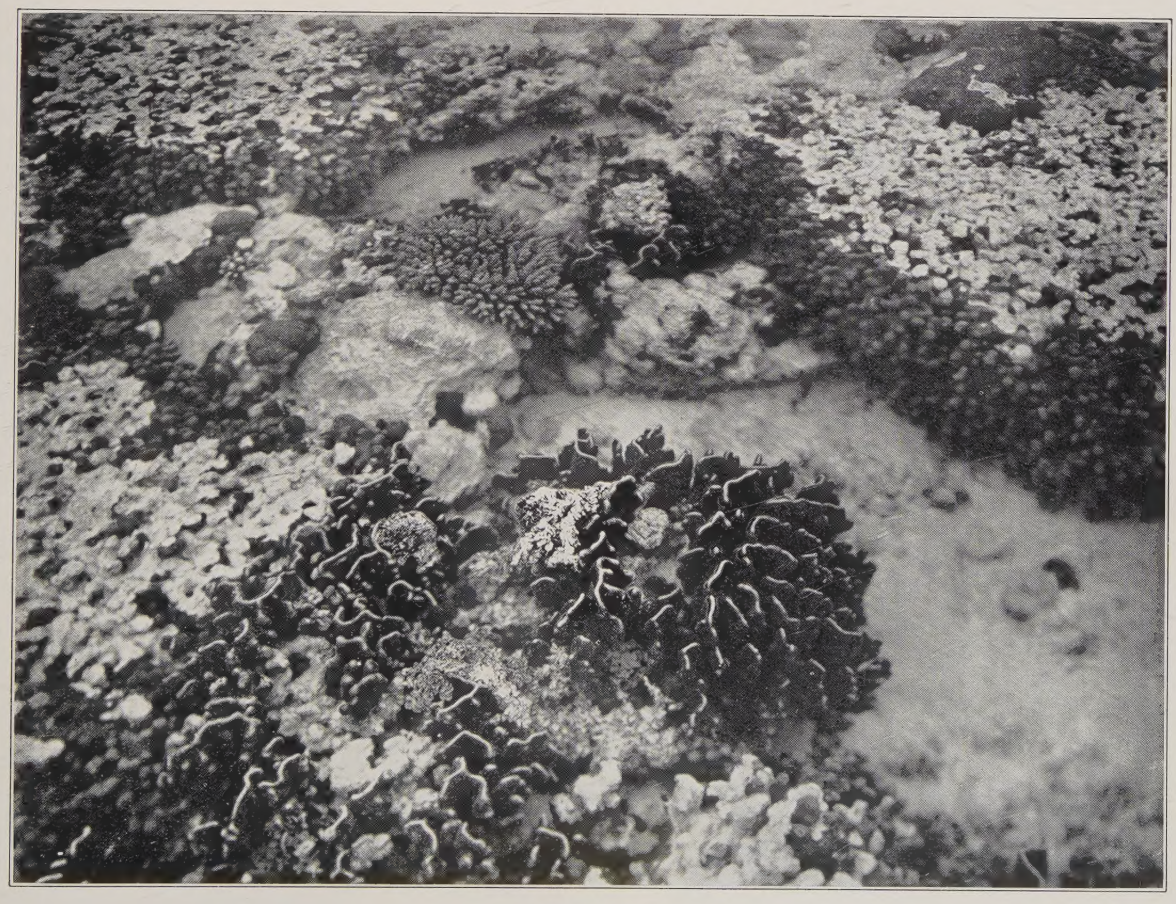

FIG. 2.

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